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APPL NO.:**10/718,351** UNIT ART NO: **3749** FILING DATE: **11-21-2003** EXAMINER: **ALFRED BASICHAS**

INVENTION TITLE: **A METHOD AND DEVICE FOR COMBUSTING LIQUID FUELS USING HYDROGEN**

CONFIRM. NO.: **9879**

AMENDMENTS TO THE CLAIMS

What is claimed and desired to be secured by United States Letters Patent is:

1. (currently amended) A method of combusting a liquid primary fuel comprising the steps of:

establishing a zone of ~~(combusting hydrogen)~~ combustion, spaced from a fuel nozzle, and defined by a flame of ignited hydrogen,

~~injecting a mechanically atomized stream of liquid primary fuel through the zone of combusting hydrogen such that a substantial portion of the liquid primary fuel contacts the hydrogen flame front and hot product gases, and~~

~~igniting the vaporized portion of the primary fuel by the hydrogen flame.~~

dispersing a liquid primary fuel through said nozzle into the zone of combustion in a partially vaporized and partially atomized state, and

burning the vaporized liquid primary fuel and the atomized liquid primary fuel entering said zone of combustion.

2. (currently amended) The method of claim 1 wherein the ~~hydrogen combustion zone~~ zone of combustion is established by the steps of:

providing ~~flowing~~ a pressurized source of hydrogen ~~at a controlled rate~~ through a ~~plurality~~ conduits ~~each with~~ having a discharge opening adjacent to ~~into~~ said ~~hydrogen combustion zone~~ zone of combustion,

igniting the hydrogen ~~discharging from the conduits~~ discharged through said discharge opening to produce a hydrogen flame; and

rotating the ~~conduits about a central axis to simulate a continuous zone of combusting hydrogen~~ hydrogen flame about a longitudinal axis of the zone of combustion.

3. (currently amended) The method of claim 2, further comprising the step of setting a speed of the rotating hydrogen flame to optimize a combustion efficiency of the primary fuel. ~~increasing the rotational speed of the conduits to maximize the combustion efficiency of the primary fuel is achieved.~~

4. (currently amended) The method of claim 2 where the source of hydrogen flowing through the ~~plurality of~~ conduits comprises a predetermined mixture of hydrogen and oxygen ~~consists of a 2-to-1 molar ratio of hydrogen and oxygen generated from the electrolysis of water~~.

5. (currently amended) The method of claim 2 wherein said discharge opening is radially spaced from said longitudinal axis and ~~plurality of conduits is two, spaced equidistantly and equicentricly around the central axis of rotation with the axis of each discharge opening~~ angled toward the central axis of rotation.

6. (currently amended) The method of claim 2 wherein a speed of the rotating hydrogen flame in a circumferential direction is not less ~~The rotation speed of a point center to the discharge of said conduits is at least equal to or greater~~ than the forward flame velocity of the ~~combusting~~ ignited hydrogen.

7. (currently amended) The method of claim 1 wherein said step of dispersing said liquid primary fuel further comprises flowing a pressurized source of liquid primary fuel through a conduit of a rotating shaft and including a discharge end having an atomizing nozzle to discharge the liquid primary fuel into the zone of combustion. ~~injection of liquid primary fuel further comprises the step of flowing a pressurized source of liquid primary fuel at a controlled rate through a plurality of conduits rotating about a central axis with the discharge end of each conduit fitted with a liquid atomizing nozzle which discharges the primary fuel into the zone of combusting hydrogen.~~

8. (canceled)

9. (currently amended) The method of claim 1 where said primary fuel is selected ~~taken~~ from the group ~~consisting of: 1)~~ comprising processed and unprocessed vegetable oils, ~~2)~~ by-product oils from agricultural products processing, ~~3)~~ liquid ~~or~~ and liquefied petroleum fuels~~, or 4)~~ and liquid ~~or~~ and liquefied animal fats.

10. (currently amended) The method of claim 2 where the steps of ~~flowing the~~ providing pressurized hydrogen from the hydrogen source further includes the steps of:

generating a constant rate of hydrogen and oxygen gases from the electrolysis of water ~~by regulating the electrical current input to the electrolysis cell~~, and

transferring the hydrogen and oxygen gases into a fixed-volume staging chamber ~~formed around the central axis of rotation~~ such that the hydrogen and oxygen gases are continuously exposed to an inlet openings of ~~the rotating~~ conduits.

11. (currently amended) The method of claim 1 further including a step of injecting a controlled rate of an additive selected from steam or water into the zone of combustion ~~wherein an additional step of injecting a controlled rate of water or steam into the zone of combusting hydrogen is used~~ to control the formation of oxides of nitrogen.

12. (currently amended) The method of claim 11 wherein the injection of said additive ~~water~~ is accomplished by pre-mixing the water at a controlled rate with the liquid primary fuel.

13. (withdrawn, currently amended) A burner for combusting a liquid primary fuel and hydrogen comprising:

~~an electrical motor,~~

~~a rigid circular shaft with a proximal end connected to the electrical motor and a distal end connected to the burner tip,~~

a rotating shaft with a proximal end and a distal end connected to a burner tip,

a pair of circular hydrogen transport ~~tubes~~ channels formed inside the rotating shaft, each ~~tube~~ channel having an inlet portion ~~channel running perpendicular to the central axis of the shaft~~ with an ~~opening on the outer surface of~~ inlet port communicating exterior to the shaft for receiving the hydrogen form a source, and ~~a shaft channel running generally parallel to central axis of the shaft for transporting the hydrogen from the inlet channel~~ an axial portion extending from said inlet portion longitudinally to a burner tip flange,

a primary fuel ~~tube~~ conduit formed inside the shaft, ~~such tube~~ said conduit having an inlet ~~channel running perpendicular to the central axis of the shaft with each end of the inlet channel opening on the outer surface of the shaft~~ port for receiving the liquid primary fuel~~,~~ and ~~shaft channel running along the central axis of the shaft~~ an axial portion running perpendicular to the longitudinal axis of the shaft for transporting the primary fuel from the inlet port to the burner tip flange,

a coolant chamber formed around the shaft closest to the distal end for containing a circulating coolant fluid,

a hydrogen ~~hydroxy~~ chamber containing a pressurized hydrogen gas source in fluid communication with said hydrogen transport channels ~~that is located adjacent to the proximal side of the coolant chamber and is formed around the shaft where the openings of the hydrogen transport tubes perpendicular to the shaft's central axis project~~, and

a primary fuel chamber containing a pressurized primary liquid fuel in fluid communication with said primary fuel conduit ~~that is located proximal to said second chamber and that is formed around said rigid shaft where the openings of the primary fuel tubes perpendicular to the shaft's central axis project.~~.

14. (cancelled)

15. (cancelled)

16. (withdrawn, currently amended) The burner of claim 13 where the ~~shaft channel section~~ axial portion of the hydrogen transport tubes extends away from the ~~central~~ longitudinal axis of the shaft at an angle between 10 and 30 degrees relative to the longitudinal axis ~~central axis of the shaft~~.

17. (withdrawn, currently amended) The burner of claim 13 wherein the burner tip is comprised of:

a solid circular flange having a proximal face attached to the end of the shaft, a distal face adjacent to a combustion zone, a hole for passing the liquid primary fuel from the primary fuel conduit ~~from the shaft~~ and a pair of holes for passing the hydrogen from the ~~shaft~~ hydrogen transport tubes,

a pair of hydrogen discharge tubes extending from the hydrogen holes and projecting ~~inserted into the hydrogen holes that project~~ away from the distal face of the flange ~~at a first distance at the same~~ in an axial direction with respect to said shaft, and then in a direction which intersects the longitudinal axis of said shaft; and

a liquid dispersing nozzle ~~inserted into~~ disposed at the primary fuel hole for discharging the primary fuel into the combustion zone.

18. (withdrawn, currently amended) The burner tip of claim 17 where said ~~first and second distances are between~~ hydrogen discharge tubes include a first axial portion having a length between 0.5 and 3 inches, an inwardly directed portion having a length between 0.5 and 3 inches, and ~~said second distance angle is~~ wherein said axial direction is defined by an angle between 22 and 60 degrees relative to the axial centerline of said axial portion of said hydrogen transport tubes.

19. (withdrawn, original) The burner of claim 13 further including an electrolytic cell for generating hydrogen and oxygen gases connected to the hydrogen chamber, where the rate of hydrogen being fed to the burner is controlled by varying the surface area of the electrolytic plates and the current input to the electrolytic cell.

20. (withdrawn, currently amended) The burner of claim 13 further including a fourth chamber around the shaft for staging a secondary ~~liquid or gaseous~~ material to be injected into a combustion zone, with the shaft including additional transport tubes located therein for transporting the secondary material to the burner tip.

21. (new) The method of claim 1 wherein the zone of combustion is defined by generally conical surface symmetric about a longitudinal axis.

22. (new) The method of claim 4 wherein that predetermined mixture of hydrogen is a molar ratio of hydrogen to oxygen having a value of 2:1.

23. (withdrawn) The method of claim 22 wherein the source of hydrogen and oxygen flowing through the conduit is obtained from the electrolysis of water.

24. (new) The method of claim 2 further comprising the steps of providing a second conduit for delivering hydrogen through a second discharge opening adjacent to the zone of combustion, igniting the hydrogen discharging through said second discharge opening to produce a second hydrogen flame, and rotating said second hydrogen flame about the longitudinal axis.

25. (new) The method of claim 25 further comprising the steps of providing a plurality of additional conduits for delivering hydrogen through additional discharge openings with said additional discharge openings extending radially outward from the longitudinal axis relative to the first two hydrogen discharge openings, igniting the hydrogen discharging through said additional conduits to produce a plurality of hydrogen flames, and rotating said plurality of hydrogen flames about the longitudinal axis in the same rotational direction as said first and second discharge openings.

26. (new) The method of claim 25 where the plurality of additional conduits for delivering hydrogen are rotated in a direction opposite to the first and second conduits along the longitudinal axis.